National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1124

Free Cutting Brass (UNS C36000)

This Standard Reference Material (SRM) is free cutting brass prepared using a continuous chill casting process. SRM 1124 is intended for use in the evaluation of chemical and instrumental methods of analysis. A unit of SRM 1124 consists of one disk approximately 39 mm in diameter and 19 mm thick, certified through its entire thickness (see "Instructions for Use"). Each unit of SRM 1124 is marked with a unique serial number in the range of 3-1 to 3-180 or 4-1 to 4-180.

Certified Mass Fraction Values: Certified values for nine constituents of SRM 1124 are reported in Table 1 as mass fractions [1]. A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or taken into account [2]. A certified value is the present best estimate of the true value based on the results of analyses performed at NIST and collaborating laboratories using the test methods identified below.

Reference Mass Fraction Values: Reference values for three constituents are reported in Table 2. Reference values are non-certified values that are the best estimates of the true values. However, the values do not meet the NIST criteria for certification and are provided with associated uncertainties that may not include all sources of uncertainty [2].

Information Mass Fraction Values: Information values for three constituents are reported in Table 3. An information value is considered to be a value that will be of interest to the SRM user, but insufficient information is available to assess the uncertainty associated with the value.

Expiration of Certification: The certification of **SRM 1124** is valid indefinitely, within the measurement uncertainties specified, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Use"). Accordingly, periodic recalibration or recertification of this SRM is not required. The certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Maintenance of SRM Certification: NIST will monitor this material over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

Coordination of the technical measurements for certification of SRM 1124 was performed by J.R. Sieber of the NIST Analytical Chemistry Division.

Measurements for homogeneity testing and value assignment of SRM 1124 were performed at NIST by T.A. Butler, J.L. Molloy, and J.R. Sieber of the NIST Analytical Chemistry Division, R. Hinchberger of Concast Metal Products, Mars, PA, and L. Dilks of Laboratory Testing, Inc., Hatfield, PA.

Statistical consultation for the value assignment of SRM 1124 was provided by S.D. Leigh of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Measurement Services Division.

Stephen A. Wise, Chief
Analytical Chemistry Division

Gaithersburg, MD 20899
Certificate Issue Date: 19 May 2011

Robert L. Watters, Jr., Chief
Measurement Services Division

INSTRUCTIONS FOR USE

Each disk of SRM 1124 is certified through its entire thickness. NIST has created the surfaces on each disk using a machine cutting technique. If it is necessary to create a new surface finish on a disk, it is recommended to use either fly cutting or lathe cutting without lubricants and coolants. If abrasive grinding is used, particles of abrasive may become embedded in the alloy resulting in anomalously high measured values for the elements present in the abrasive. In addition, pressure and localized heating may cause smearing of one or more constituent elements, thus altering the composition of the surface.

Store the SRM in a cool, dry location, preferably in its original container. The alloy is expected to remain stable provided adequate precautions are taken to protect it from contamination, extremes of temperature, and moisture.

To relate the results of analysis to the assigned values and associated uncertainty estimates for SRM 1124, a minimum of 0.25 g of chipped material for destructive test methods is recommended. For X-ray fluorescence spectrometry (XRF), common spectrometer designs use measurement areas $\geq 2\ cm^2$, which is expected to be adequate for this material. For optical emission spectrometers, such as glow discharge and arc-spark designs, the use of the average of multiple measurements is recommended for a single determination. User experience indicates that four or more "burns," each ≥ 3 mm diameter, are necessary to adequately sample the alloy.

PREPARATION AND ANALYSIS[(1)]

The material for SRM 1124 was created by a continuous chill casting process performed by Concast Metal Products, Mars, PA. The metals, silver, cadmium, and chromium, were added to the alloy to provide mass fractions in the range of 50 mg/kg to 200 mg/kg. The resulting rods were cut into disks under the direction of M.P. Cronise of the NIST Measurement Services Division.

Measurements for homogeneity testing of SRM 1124 were performed at NIST using wavelength dispersive XRF and microbeam XRF (MicroXRF) and at Concast Metal Products using spark-source optical emission spectrometry (SSOES). Lateral heterogeneity was tested using line scans across the diameters of several disks. No significant variability was detected. MicroXRF was also used to map the constituent elements in a prepared surface of one disk. Grain structure was observed, and the information was used along with other data to make recommendations for the use of the material (see "Instructions for Use"). The continuous chill casting process imparts non-uniformity of composition along the lengths of rods for elements that are lost by volatilization from the molten alloy. The distributions of cadmium and chromium in the rods were measured using XRF and incorporated in the uncertainty estimates.

Test Methods Employed at NIST and Collaborating Laboratories: Inductively coupled plasma optical emission spectrometry (ICPOES) methods were used by analysts at NIST and a collaborating laboratory after acid dissolution of chips of the material. An SSOES method was used by analysts at a collaborating laboratory after surface preparation by abrasive grinding. An XRF method was used by analysts at NIST after surface preparation by abrasive grinding. The test methods used for the determination of the constituent values are listed below.

ICPOES:	Ag, Bi, Cd, Cr, Fe, Mn, Ni, Pb, Sb, Sn
SSOES:	Bi, Cd, Fe, Ni, P, S, Sn, Zn
XRF:	Ag, Co, Cr, Cu, Fe, Mn, Ni, P, Pb, S, Sb, Sn, Zn

Value Assignment: The certified or reference value is a weighted mean of a set of results obtained using the test methods listed above [3,4]. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 2 (approximately 95 % confidence) calculated by combining a between-method variance incorporating inter-method bias with a pooled, within-method variance following the ISO Guide [5].

[(1)]Certain organizations, commercial equipment, or materials are identified in this certificate to specify adequately the experimental procedure. Such identification does not imply recommendation or endorsement by the NIST, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Table 1. Certified Mass Fraction Values for SRM 1124

Constituent	Mass Fraction (mg/kg)		
Ag	131	±	11
Cd	65.1	±	2.6
Cr	155	±	22
Sb	232.5	±	1.1

Constituent	Mass Fraction (%)		
Fe	0.2068	±	0.0053
Ni	0.0801	±	0.0015
Pb	3.363	±	0.086
Sn	0.3112	±	0.0038
Zn	35.19	±	0.30

Table 2. Reference Mass Fraction Values for SRM 1124

Constituent	Mass Fraction (mg/kg)		
Bi	202	±	43
P	224	±	43
S	31	±	17

Table 3. Information Mass Fraction Values for SRM 1124

Constituent	Mass Fraction (mg/kg)	Constituent	Mass Fraction (%)
Co	14	Cu	62.5
Mn	9		

REFERENCES

[1] Thompson, A.; Taylor, B.N.; *Guide for the Use of the International System of Units (SI);* NIST Special Publication 811; U.S. Government Printing Office: Washington, DC (2008); available at http://www.nist.gov/pml/pubs/index.cfm/ (accessed May 2011).

[2] May, W.; Parris, R.; Beck, C.; Fassett, J.; Greenberg, R.; Guenther, F.; Kramer, G..; Wise, S.; Gills, T.; Colbert, J.; Gettings, R.; MacDonald, B.; *Definitions of Terms and Modes Used at NIST for Value-Assignment of Reference Materials for Chemical Measurements;* NIST Special Publication 260-136; U.S. Government Printing Office: Washington, DC (2000); available at http://www.nist.gov/srm/publications.cfm (accessed May 2011).

[3] DerSimonian, R.; Laird, N.; *Meta-analysis in Clinical Trials*; Control Clin. Trials, Vol. 7, pp. 177–188 (1986).

[4] Horn, R.A., Horn, S.A.; Duncan, D.B., *Estimating Heteroscedastic Variance in Linear Models*; J. Am. Stat. Assoc., Vol. 70, pp. 380–385 (1975).

[5] JCGM 100:2008; *Evaluation of Measurement Data — Guide to the Expression of Uncertainty in Measurement* (ISO GUM 1995 with Minor Corrections); Joint Committee for Guides in Metrology (JCGM) (2008); available at http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf (accessed May 2011); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297; U.S. Government Printing Office: Washington, DC (1994); available at http://physics.nist.gov/Pubs/ (accessed May 2011).

Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 926-4751; e-mail srminfo@nist.gov; or via the Internet at http://www.nist.gov/srm.